



# TES comparisons of water vapor with aircraft and sondes

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Aura Validation Workshop - Water Subgroup

- TES jointly retrieves  $O_3$ , T,  $H_2O$  so water accuracy is important.
- Aircraft and sondes provide local meteorological context for TES retrievals.
- We will examine the variability of water vapor in the middle and upper troposphere.



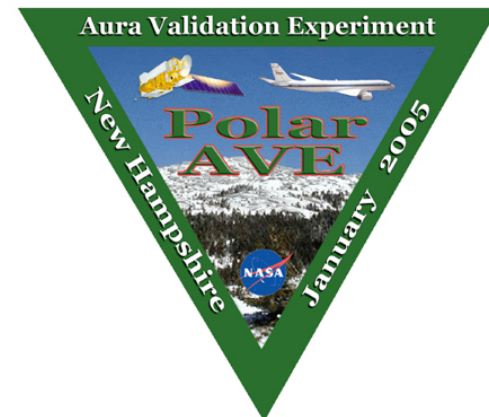
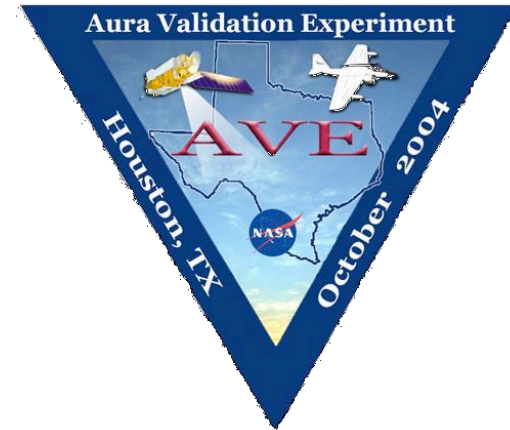
# TES Retrievals



- TES retrievals shown here are from the IDL sav files, similar to release 7 (Version 1 data at the DAAC).
- L2 profiles of tropospheric water vapor.
- Step and Stare special observations during the AVE and PAVE missions.
- TES error bars shown are the combined random and cross-state errors.
- TES retrievals shown here have been filtered for retrieval quality (e.g. radiance residual rms below 1.4).

## Aura Validation Experiment

- AVE Oct (Houston):  
WB-57 high-altitude aircraft,  
Oct-Nov 2004.
- AVE Oct (Houston):  
ozonesondes launched by Gary  
Morris, Oct-Nov 2004.
- PAVE (Portsmouth, NH):  
NASA DC-8 aircraft,  
Jan-Feb 2005.



- Define  $X = \ln[\text{H}_2\text{O}]$ .
- Interpolate the *in situ* data to the same 87-level grid as TES.
- Apply TES averaging kernel  $A_{TES}$  and the TES *a priori* constraint  $X_{apriori}$  to the *in situ* data:

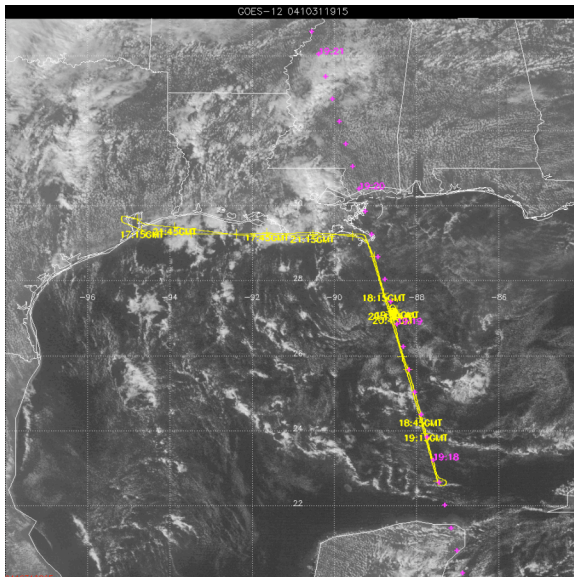
$$X_{sonde}^{TES_{AK}} = X_{apriori} + A_{TES} [X_{sonde}^{pTES} - X_{apriori}]$$

where  $X_{apriori} = \ln[\text{H}_2\text{O}]$  interpolated from GMAO values.

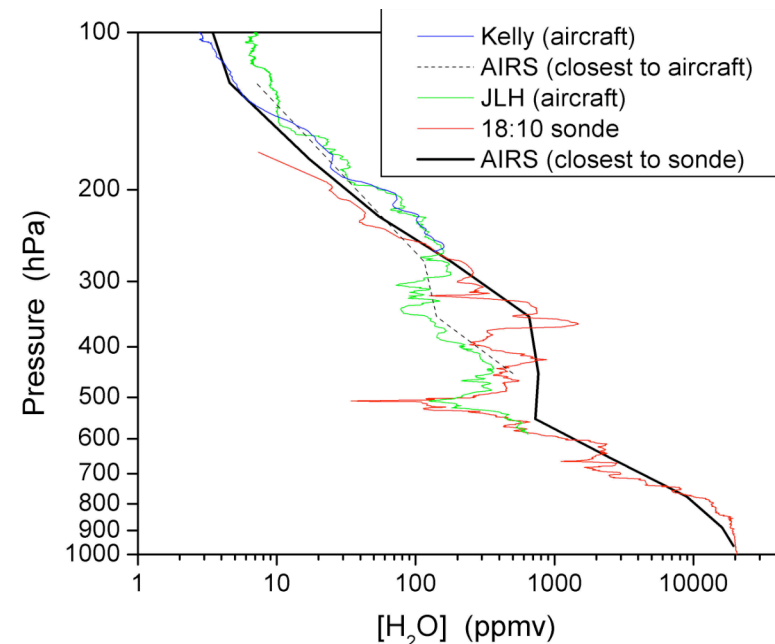
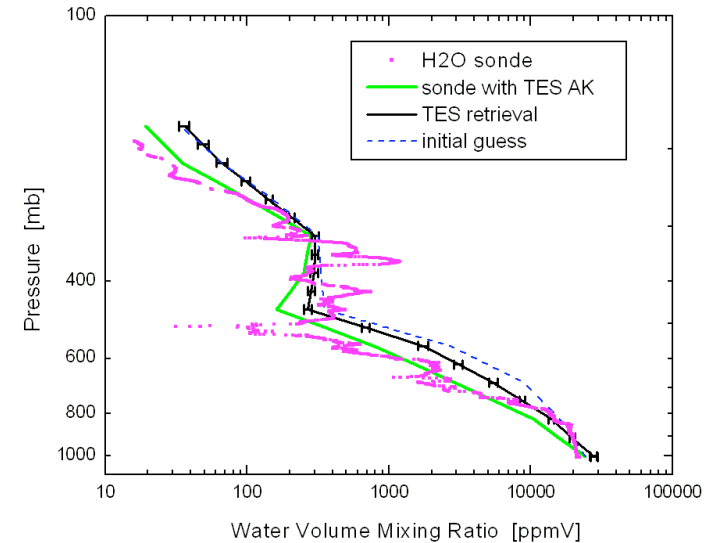
# AVE - 31 Oct 2004 (coastal)



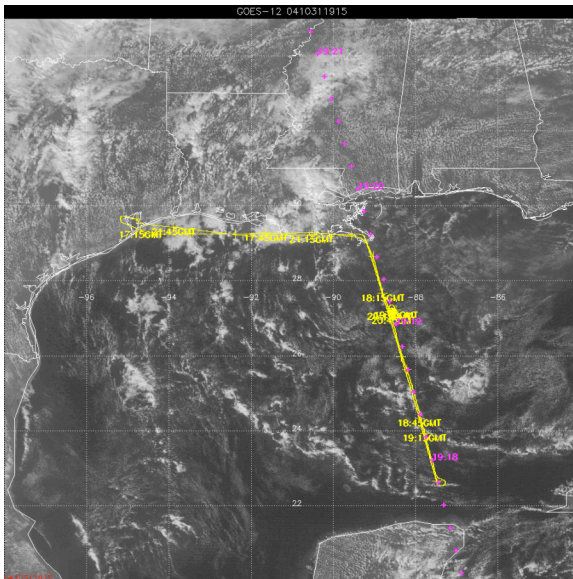
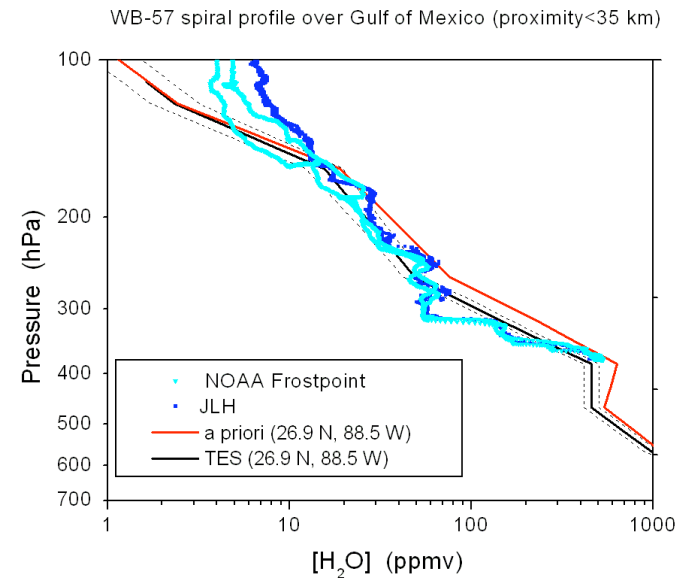
- WB-57 takeoff and Rice Univ. sonde.
- Sonde H<sub>2</sub>O measurements by Vaisala RS80 sensor have a dry bias in UT.
- Spatial variability is apparent - even near Houston.



Houston sonde profile of water, 2004-10-31, run 2262, dist=580 km, time~1.2 hr



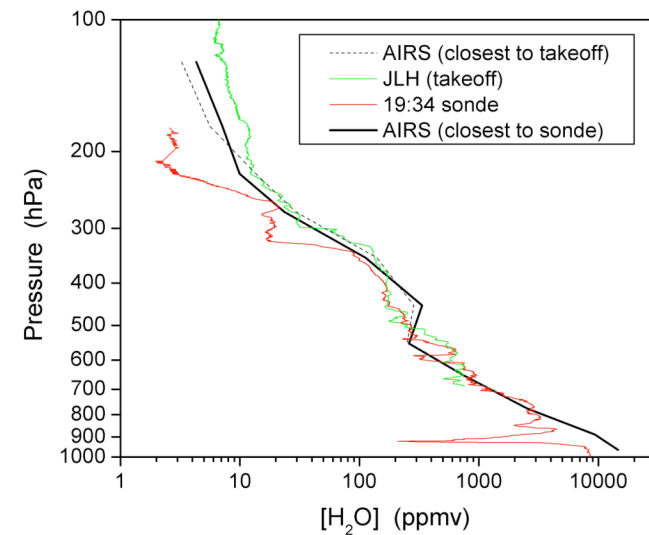
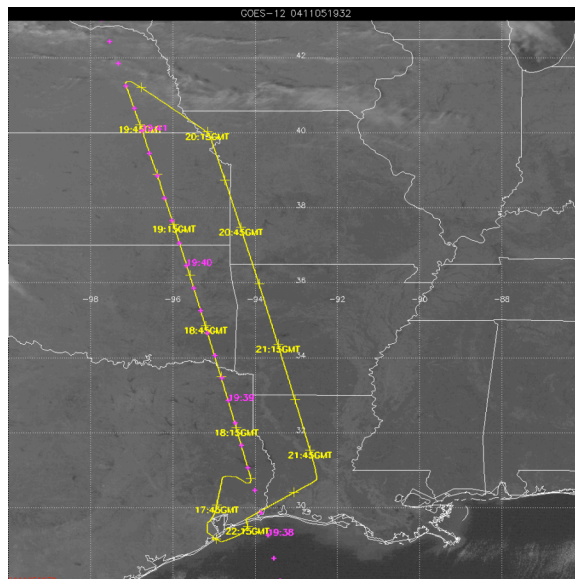
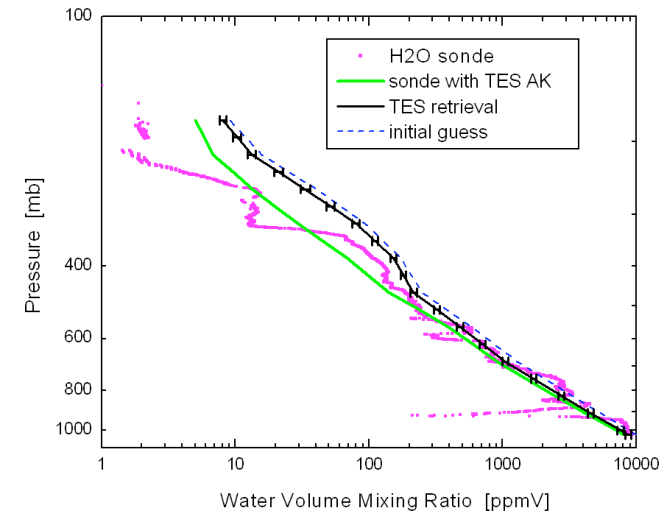
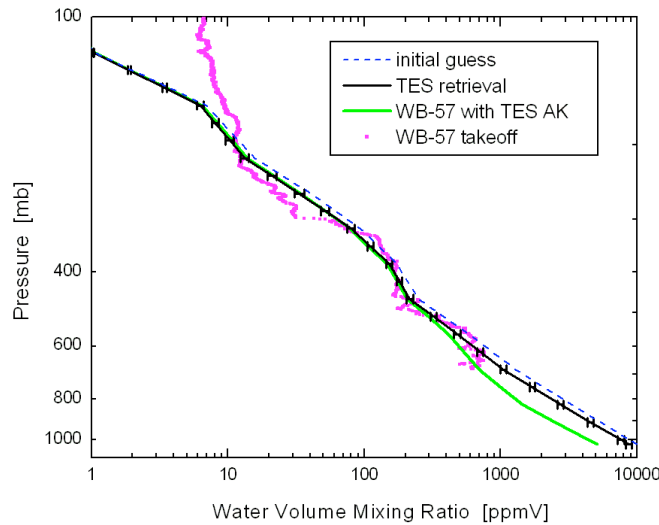
- This WB-57 spiral over the Gulf of Mexico is the closest spatial match to a TES Step and Stare point (within 18 km).
- Good comparison over a limited range of altitudes.



# AVE - 5 Nov 2004 (coastal)

- WB-57 takeoff and sonde within 146-km proximity of TES Step and Stare, sonde dry bias in UT.

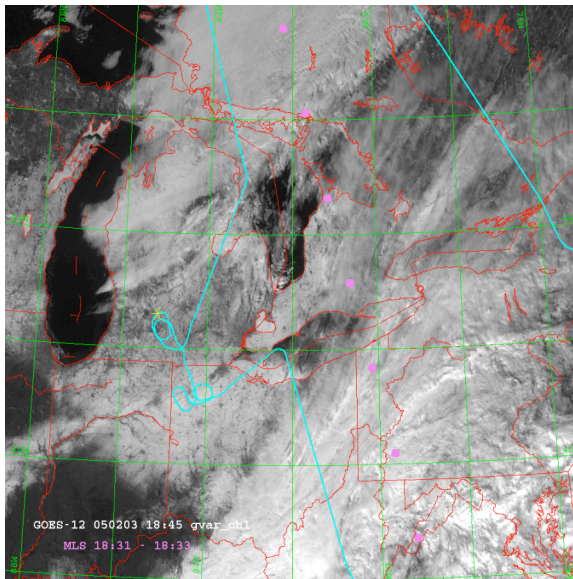
Houston sonde profile of water, 2004-11-05, run 2290, dist=146 km, time<1 hr



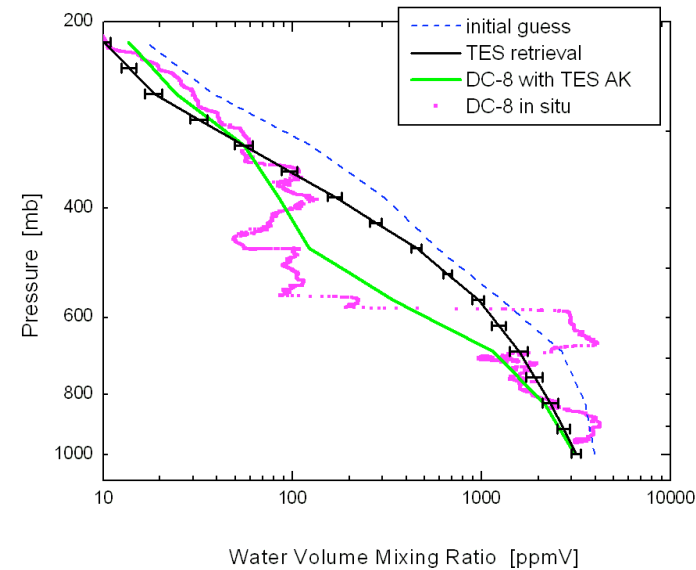


# PAVE - 3 Feb 2005 (over land)

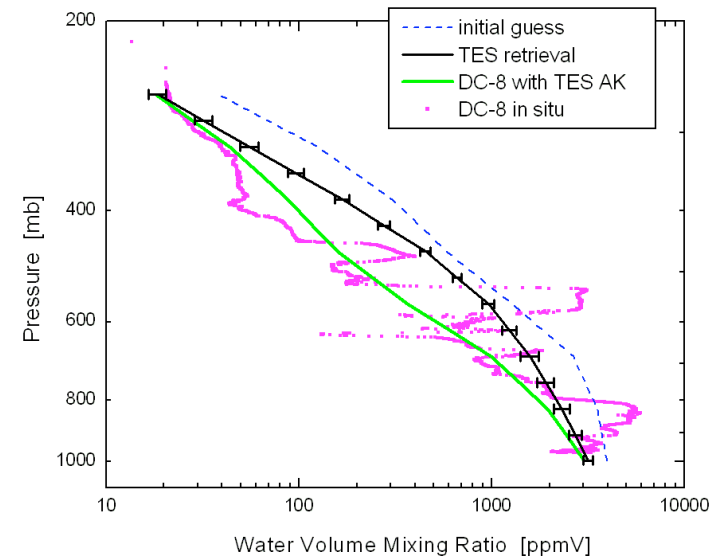
- DLH *in situ* water on the NASA DC-8.
- DC-8 profile from 200 to 960 mbar.
- Highly variable meteorology over Ohio and Michigan limits the usefulness of this comparison.



PAVE DC-8 water, 3 Feb 2005, run 2614



PAVE DC-8 water, 3 Feb 2005, run 2614



- Water comparisons have been carried out between TES L2 retrievals, aircraft, and sondes.
- Reasonable agreement in the lower and middle troposphere.
- High spatial variability of tropospheric water vapor suggests that a very large number of profiles are required to compare water with TES.



# Acknowledgments



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